



PATENT
1928-0156P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: Kevin King Wai LAU Conf.:
Appl. No.: 10/642,745 Group:
Filed: December 18, 2003 Examiner:
For: A MOTOR AND GEARBOX COMBINATION

L E T T E R

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 5, 2004

Sir:

Under the provisions of 35 U.S.C. § 119 and 37 C.F.R. § 1.55(a), the applicant(s) hereby claim(s) the right of priority based on the following application(s):

<u>Country</u>	<u>Application No.</u>	<u>Filed</u>
GREAT BRITAIN	0229969.1	December 21, 2002

A certified copy of the above-noted application(s) is(are) attached hereto.

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Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

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Attachment(s)





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10/642, 745
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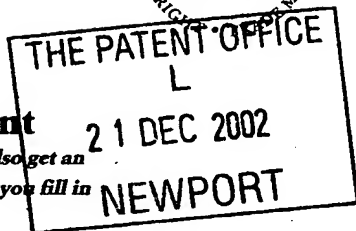
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27DEC02 E773246-6 002896
P01/7700 0.00-0229969.1

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The Patent Office

Cardiff Road
Newport
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NP10 8QQ

1. Your reference

MRH.PO4744GB

2. Patent application number

(The Patent Office will fill in this part)

21 DEC 2002

0229969.1

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Johnson Electric S.A.
Rue Fritz-Courvoisier 40
CH-2300 La Chaux-de-Fonds
Switzerland

04018313005

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

Switzerland

4. Title of the invention

A MOTOR AND GEARBOX COMBINATION

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Marks & Clerk
27 Imperial Square
Cheltenham
GL50 1RQ

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18014

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
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Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
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Patents Form 1/77

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Description

7

Claim(s)

3

Abstract

1

Drawing(s)

2 + V

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Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

1

Request for substantive examination (Patents Form 10/77)

Any other documents
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Mark R Higgins

Date

Marks & Clerk

20th December 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr M R Higgins
01242 524520

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A MOTOR AND GEARBOX COMBINATION

This invention relates to a motor and gearbox combination for use in a portable power tool and more particularly, but not necessarily, for use in a portable
5 hand held drill.

Portable hand held tools such as drills are driven by electric motors, either battery or mains powered. To increase the output torque of the drill, the motor drives the chuck through a speed reduction gear train. To keep the drill compact and for
10 maximum drilling force, epicyclic gear boxes are preferred.

Conventionally, drill manufacturers have received a motor and a separate gearbox complete with an output shaft. The motor and gearbox have been connected together using a special adaptor plate and then the combined motor and gearbox has
15 been assembled into the casing of the drill. This approach has worked well in aligning the motor to the gearbox but there has been little room for reducing the overall length of the drill as desired by current market trends.

The present invention seeks to provide a compact and reliable motor and gear
20 box combination.

According to the invention, there is provided a motor and gearbox

combination for use in a portable power tool, having:

a motor section comprising:

- a motor housing having a first end and an open second end,
- a first bearing supported at the first end of the motor housing,
- 5 a stator fixed to the motor housing,
- a cap closing the open second end of the motor housing and supporting
- a second bearing,
- a motor shaft journaled at one end in the first bearing and at the other
- end in the second bearing, and a rotor mounted on the motor shaft in
- 10 confrontation with the stator,

a gearbox section comprising:

- a gearbox housing accommodating a gear train and an output shaft
- characterised in that the cap is connected to the gearbox housing and
- the cap and gearbox housing enclose the motor housing.

15

Preferably, the cap extends over the motor housing and is connected to the gearbox housing at or adjacent to the first end of the motor housing.

- Preferably, the motor is a PMDC motor having a permanent magnet stator and
- 20 a wound rotor including a commutator, and the cap supports brush gear in contact
- with the commutator.

Alternatively, the motor may be a brushless D.C. motor or a universal type motor.

Advantageously, the gear train is an epicyclic gear train. In this case, the
5 epicyclic gear train, preferably, is a two-stage planetary gear system comprising a
first sun gear connected to the motor shaft, a first carrier plate, a ring gear
surrounding the carrier plate, a plurality of first planet gears in mesh with the first
sun gear and the ring gear and supported by the first carrier plate for driving the first
carrier plate, a second sun gear connected to the first carrier plate, a second carrier
10 plate and a plurality of second planet gears in mesh with the second sun gear and the
ring gear and supported by the second carrier plate for driving the second carrier
plate.

The ring gear may be formed as a metallic sleeve which is pressed into the
15 gearbox housing or the gearbox housing could be a moulded part of synthetic resin
and the teeth of the ring gear could be moulded directly onto the gearbox housing.

The invention will now be more particularly described, by way of example
only, with reference to the accompanying drawings, in which:

20

Figure 1 is a partly sectional side view of a preferred embodiment of a motor
and gearbox combination according to the present invention, and

Figure 2 is an exploded perspective view of the motor and gearbox combination shown in Figure 1.

Referring to the drawings, the motor and gearbox combination shown therein is suitable for use in a hand held power tool such as a drill or electric screwdriver. The combination has a compact overall length. The combination can be divided into two sections, namely a motor section 11 and a gearbox section 12 which includes an output section 13.

The motor section 11, shown on the right, incorporates a D.C. motor having a permanent magnet stator and a wound rotor. The rotor has a shaft 14, a rotor core 15 and a commutator 16 fitted to the shaft 14, with rotor winding 17 wound around the rotor core 15 and terminated on the commutator 16.

The stator has permanent magnets 18 disposed inside a deep drawn motor housing 19 having a first end supporting a bearing 20 and an open second end. A flux ring in the form of a sleeve 21 may, as shown, extend externally around the housing 19. A cylindrical moulded synthetic resin cap 22 closes the open second end of the motor housing 19 and is a sliding fit over the motor housing 19 to which it is keyed by elongate ribs 22a (see Figure 2) on the cap 22 and slots in the open end of the housing 19. The end of the cap 22 supports a bearing 23, brush gear 24 and motor terminals 25. The bearing 23 is a self-aligning oil impregnated sintered bronze

bushing in which one end of the rotor shaft 14 is journalled. The other end of the rotor shaft is journalled in the bearing 20.

The gearbox section 12 has a gearbox housing 26 which is directly connected
5 by bolts 45 to the open end of the cap 22 at or adjacent to the first end of the motor housing 19. The gearbox housing 26 accommodates a gear train and extends into the output section 13 to support output shaft 27. The gear train is a double or two stage planetary gear type speed reduction gear train.

10 The cap 22 and gearbox housing 26 are formed of moulded synthetic resin material.

Each stage has a gear carrier 28, 29 which supports three planet gears 30, 31 respectively on spigots 32, 33 respectively. The three first stage planet gears 30
15 engage a first sun gear 34 in the form of a pinion on the motor shaft 14 and also engage teeth formed on the inner wall of a separate ring gear 35 formed as a metallic sleeve pressed into the housing 26 (as shown) or formed directly on an inner wall of the gearbox housing. Thus, when the motor turns, the pinion or sun gear 34 drives the first planet gears 30 around the inner wall of the housing 26, in turn rotating the
20 first gear carrier 28 via first spigots 32. To the left of the first stage planetary gear is the second stage planetary gear. Again, the second stage planet gears 31 engage a second sun gear 36 and the teeth formed on the inner wall of the gearbox housing

26. The second sun gear 36 is fixed to the rear surface of the first carrier 28 for rotation therewith. The output shaft 27 is fixed to the rear surface of the second carrier 29 for rotation therewith and is supported by a long bushing 37 pressed into the left hand end of the gearbox housing 26. A thrust bearing assembly 38 is located
5 between the bushing 37 and a retaining ring 39 fitted to a circumferential groove in the output shaft 27 to accept thrust loading applied to the output shaft 27.

The motor shaft 14, output shaft 27 and the first and second sun gears 34 and 36 are all co-axial. A washer 40 is placed between the long bushing 37 and the
10 second carrier 29. A second washer 41 is placed between the ring gear 35 and the closed end of the motor housing 19.

Conventionally, the motor and gearbox combination is also provided with a torque spring 42, clutch cap 43 and mounting plate 44. A hammer mechanism could
15 also be included.

The combined motor and gearbox described above is axially compact making it possible for the power tool manufacturers to make shorter and lighter tools.

20 Although a PMDC motor has been described, other types of motor such as brushless D.C. motors, universal motors and other A.C. motors may be used by suitable adaptation of the motor parts involved.

The embodiment described above is given by way of example only and various modifications will be apparent to persons skilled in the art without departing from the scope of the invention as defined by the appended claims. For example, the gearbox could be a one-stage or a three-stage gearbox and a three-stage gearbox may provide

5 a three-speed gear train.

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CLAIMS

1. A motor and gearbox combination for use in a portable power tool, having:
a motor section comprising:
 - 5 a motor housing having a first end and an open second end,
a first bearing supported at the first end of the motor housing,
a stator fixed to the motor housing,
a cap closing the open second end of the motor housing and supporting
a second bearing,
 - 10 a motor shaft journaled at one end in the first bearing and at the other
end in the second bearing, and a rotor mounted on the motor shaft in
confrontation with the stator,a gearbox section comprising:
 - a gearbox housing accommodating a gear train and an output shaft
 - 15 characterised in that the cap is connected to the gearbox housing and the cap and
gearbox housing enclose or substantially enclose the motor housing.
2. A combination as claimed in claim 1, wherein the cap extends over the motor
housing and is connected to the gearbox housing at or adjacent to the first end of the
20 motor housing.
3. A combination as claimed in claim 1 or claim 2, wherein the motor is a

PMDC motor having a permanent magnet stator and a wound rotor including a commutator and the cap supports brush gear in contact with the commutator.

4. A combination as claimed in claim 1 or claim 2, wherein the motor is a
5 brushless D.C. motor.
5. A combination as claimed in claim 1 or claim 2, wherein the motor is a
universal type motor.
- 10 6. A combination as claimed in any one of the preceding claims, wherein the gear
train is an epicyclic gear train.
7. A combination as claimed in claim 6, wherein the epicyclic gear train is a two
stage planetary gear system comprising a first sun gear connected to the motor shaft,
15 a first carrier plate, a ring gear surrounding the carrier plate, a plurality of first planet
gears in mesh with the first sun gear and the ring gear and supported by the first
carrier plate for driving the first carrier plate, a second sun gear connected to the first
carrier plate, a second carrier plate and a plurality of second planet gears in mesh with
the second sun gear and the ring gear and supported by the second carrier plate for
20 driving the second carrier plate.
8. A combination as claimed in claim 7, wherein the ring gear is formed as a

metallic sleeve which is pressed into the gearbox housing.

9. A combination as claimed in claim 7, wherein the gearbox housing is a moulded part of synthetic resin and the teeth of the ring gear are moulded directly
- 5 onto the gearbox housing.

ABSTRACTA MOTOR AND GEARBOX COMBINATION

The motor and gearbox combination is for use in a portable power tool having
5 a motor section 11 and a gearbox section 12. The motor section comprises a motor
housing 19 having a first end and an open second end, a first bearing 20 supported
at the first end of the motor housing, a stator fixed to the motor housing, a cap 22
closing the open second end of the motor housing and supporting a second bearing 23
and a motor shaft 14 journalled at one end in the bearing 20 and at the other end in
10 the bearing 23, and a rotor 15 mounted on the motor shaft in confrontation with the
stator. The gearbox section 12 comprises a gearbox housing 26 accommodating a
gear train and an output shaft 27. The cap 22 is connected to the gearbox housing 26
at or adjacent to the first end of the motor housing and encloses or substantially
encloses the motor housing 19.

15

(Refer to Figure 1)



1/2

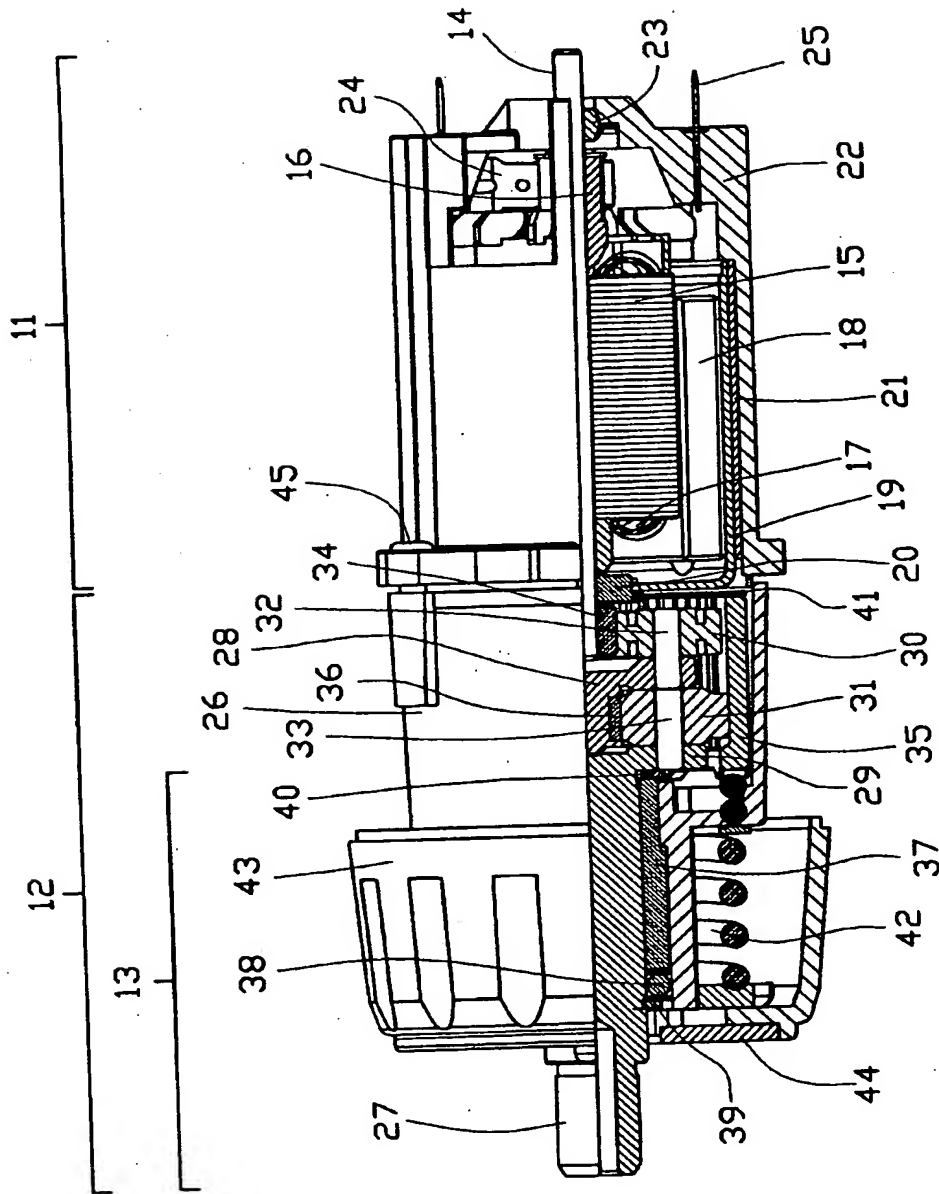


FIG. 1



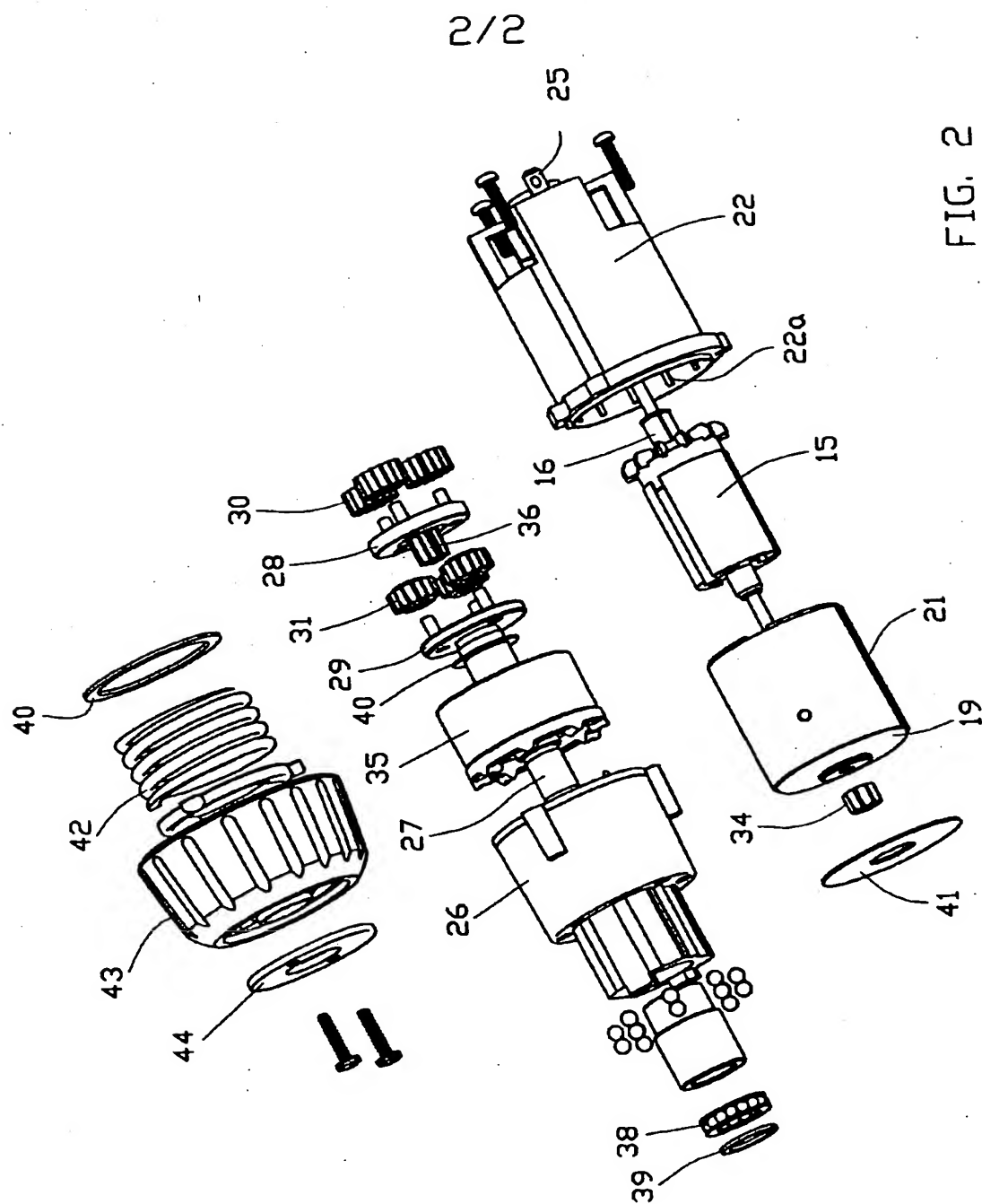


FIG. 2

